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WATER QUALITY DATA - AN INCREASING NATIONAL NEED

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Cincinnati, Ohio

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WATER QUALITY DATA - AN INCREASING NATIONAL NEED 1/

by

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The need for fundamental information which can be used to establish long-term trends in water quality, and the usefulness of such data in our overall water resources planning are both well recognized.

The Public Health Service program for the collection of basic data on water quality has been previously described (1,2). Briefly, under Section 4 (c) of Public Law 660, 84th Congress, the Public Health Service "shall, in cooperation with other Federal, State, and local agencies having related responsibilities, collect and disseminate basic data on water quality insofar as such data or other information relate to water pollution and the prevention and control thereof." The objective for Fiscal Year 1958 has been the establishment of 50 water sampling stations on the Great Lakes and interstate streams of the United States. At each of these stations, samples of raw water are being collected periodically and analysed for radioactivity, organic chemical content, plankton populations, coliform organisms, and the conventional physical and chemical determinations. This latter group

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1/ For presentation at the "Panel Discussion - Stream Water Quality Monitoring", 78th Annual Convention, American Water Works Association, Dallas, Texas, April 21-24, 1958.

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includes temperature, dissolved oxygen, pH, biochemical oxygen demand, chemical oxygen demand, chlorine demand, ammonia nitrogen, chlorides, alkalinity, hardness, color, turbidity, sulfates, and total dissolved solids. Later, the program will also include data on fish populations and the enumeration of other aquatic organisms.

PILOT METHOD OPERATION

Prior to the initiation of this program, the Public Health Service established a pilot network of 10 stations across the United States. The principal objectives of this initial network were to:

(a) develop a base from which the broader national program could be expanded;

(b) provide preliminary data on waters of widely differing quality, for use in selecting laboratory procedures; and

(c) provide an opportunity for discussing the broad concept of such a program in various parts of the United States, and thus obtain advice and comments valuable in the development of the broadened program.

Although the pilot network was operated for only some six months, the data gathered were sufficient to yield useful information, including differences in pollutional levels between river basins, as well as within the same basin. The data are presented in Figures 1, 2, and 3, and include results for radioactivity, total algae, and organic chemicals at eight of the ten stations sampled.

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ORGANIC CHEMICALS

When several thousand gallons of water are passed through a filter containing activated carbon the organic chemicals present are adsorbed onto the carbon. Removal and recovery of the organics from the carbon are accomplished by extraction with chloroform and then with alcohol, in accordance with the technique developed by Middleton et al(3,4). Organic pollutants originating from the various chemical manufacturing industries as well as petroleum-based pollutants are recovered in the chloroform extract. The alcohol extractables contain detergents, as well as materials originating from algal activity, organic matter in soil, decay of vegetation, and other natural sources.

Figure 1 shows the concentrations of chloroform and alcohol extractables recovered from eight stations. The Colorado and Columbia Rivers contain the lowest concentrations of organics, especially the chloroform extractables. The Detroit and Merrimack Rivers and many-fold higher concentrations of total organics, particularly the chloroform extracts. This shows that both streams receive considerable industrial pollution above the sampling sites.

The Mississippi and Missouri Rivers lie between the two extremes. The three Mississippi River stations show about the same concentration of organics at Minneapolis, Quincy, and New Orleans, indicating a counter balanced effect between new pollution, assimilation by the stream, and increasing flows.

PLANKTON AND ALGAE

Total algae are presented in Figure 2. The highest counts were experienced on the Mississippi River at Quincy, where a maximum of 142,000 per ml. occurred in March. Counts above 10,000 and 17,000 were experienced on the Mississippi River at Minneapolis and on the Missouri River at Kansas City, respectively. The organism predominating at most of these stations throughout this period was Cyclotella, which is well known as a taste and odor producer and as a filter clogger. Many other forms were identified. Dinobryon and Peridinium, notorious for taste and odor production in water supplies, were dominant in two of the streams during May and June. Other dominant forms included Melosira, Asterionella, Stephanodiscus, Navicula, Diatoma, Synedra, Chlorella, Scenedesmus, and Ankistrodesmus. A number of these are particularly important as filter clogging organisms. At several stations significant numbers of protozoan ciliates, rotifers, and crustacea were also present, in addition to the algae.

RADIOACTIVITY

Figure 3 presents the total beta radioactivity counts. Levels are above normal background in the Columbia River, since this station is below the Hanford Works of the Atomic Energy Commission. Although the counts are above the provisional levels of permissible concentrations recommended in handbook 52(5) for use beyond the control area, the activity at this station is due principally to short, half-lived, induced radioactive materials having higher permissible concentrations individually.

The levels occurring during June on the Missouri and the Mississippi Rivers were much higher than the normally experienced background. Several nuclear weapons tests occurred in Nevada during the month of June. Prevailing winds evidently carried the radioactive materials in an easterly direction. The high counts at Kansas City and at Quincy reflect the fall-out due to these tests. The lower levels at New Orleans reflect a combination of natural decay, assimilation by stream life, and dilution of the materials introduced at the upstream points.

AREAS FOR FURTHER DEVELOPMENT

Operation of the pilot network pointed up several needs. A problem which must be resolved before a more comprehensive program can be developed to its maximum value is automatic instrumentation at the sample site. Some of the more significant parameters of water quality, such as temperature, pH, dissolved oxygen, and the various "demand" measurements, are fugitive in nature and fluctuate continuously through the influence of hourly changes in air temperature, sunlight intensity, stream flow, and other natural factors. It is highly important that maxima and minima be recorded, since these may not be represented by analyses of periodic grab samples. Every effort should be made to develop instrumentation which can provide this type of data.

Another important need, and one which will become more urgent as the rate of water use increases through the greater economic development of our Nation, is that of new parameters which can be

used more effectively in the future evaluation of water quality. It is well known that tremendous increases in water use have occurred due to recent rapid economic expansions. These expansions have already placed additional strains in areas of water shortage. What is most important, however, is that the wastes emanating from many of these new sources are fundamentally different from wastes which water pollution control authorities have dealt with in the past. New, simple, and meaningful parameters must be used to characterize these new and in many cases, insidious pollutants. One such parameter already put to use is the Carbon Filter Technique for the measurement of organics in water. Other techniques are needed now to provide new armament with which to attack the rapidly increasing proolems of water quality evaluation.

PRESENT PROGRAM OPERATIONS

The present program has evolved from the pilot study. By April 1, 1958, 44 stations had been established and were in operation. Negotiations were underway for an additional 6 stations to complete the initial 50 stations of the Nationwide water quality program. Figure 4 shows the location of the stations in the expanded network.

Water users at the sampling sites have been integrated into and are actively participating in the operations. Of the 44 stations already established, 40 are located at intakes of existing water treatment plants, utilize the manpower of a nearby water plant, or both. In most instances the water plant involved is contributing

not only the personnel services needed for the collection and shipment of the various samples to the SEC, but also on a weekly schedule the analytical data on raw water covering conventional chemical and physical examinations previously enumerated. In several instances, water departments have volunteered their cooperation even though they do not use the stream as a source of raw water. Others participating directly in the program include 3 State health Department laboratories, 4 local health department laboratories, 1 Sanitary Authority laboratory, 6 Federal agencies other than the PHS, and 4 industrial establishments.

The Water Quality Basic Data Program will not remain static. As new parameters are developed and are found significant, the program will be modified accordingly. New tests will be included and old ones dropped whenever the needs of the program require. Certain areas may require additional special analyses, and these will be added. Other areas may require less intensive effort. The information which a program of this type produces can be most useful only if it is kept current with the developments in water resources planning and water quality evaluation.

SUMMARY

This paper has presented examples of what water quality data developed on a nation wide basis can show. A program of this type should not be considered a "monitoring" or "surveillance" program - a better name for it would be an "intelligence service." It should

provide the means for continuous evaluation of the quality of our water resources so that when any necessary corrective action is indicated, a warning or "alert" can be flashed. This warning should designate the general area needing relief and the degree of correction necessary. The basic data program is not intended to and should not take the place of detailed field surveys required for the solution of local problems.

The Federal network will provide data for interstate and international streams, and for areas affected by Federal installations. These data will be published annually as a Government publication available to all. It is hoped that the States and other local agencies responsible for water resources will develop intrastate programs which can be tied with the National network, using the Federal stations as reference points.

In addition to the principal benefits to be gained through the collection and publication of these fundamental data, the program has already stimulated activities at many water plants. This activity has resulted in more comprehensive laboratory coverage and increased utilization of the newer parameters for assessment of water quality. Also, through the PHS Analytical Reference Service participants in this program have the opportunity to evaluate the precision and accuracy of their own laboratory data. Another benefit is thus gained through improvement of laboratory competency.

It is presently anticipated that our responsibility can be adequately covered by a maximum of 250 to 300 stations. When supplemented by intrastate programs, these should provide the data necessary for all future efforts aimed at the preservation and maximum utilization of our Nation's water resources.

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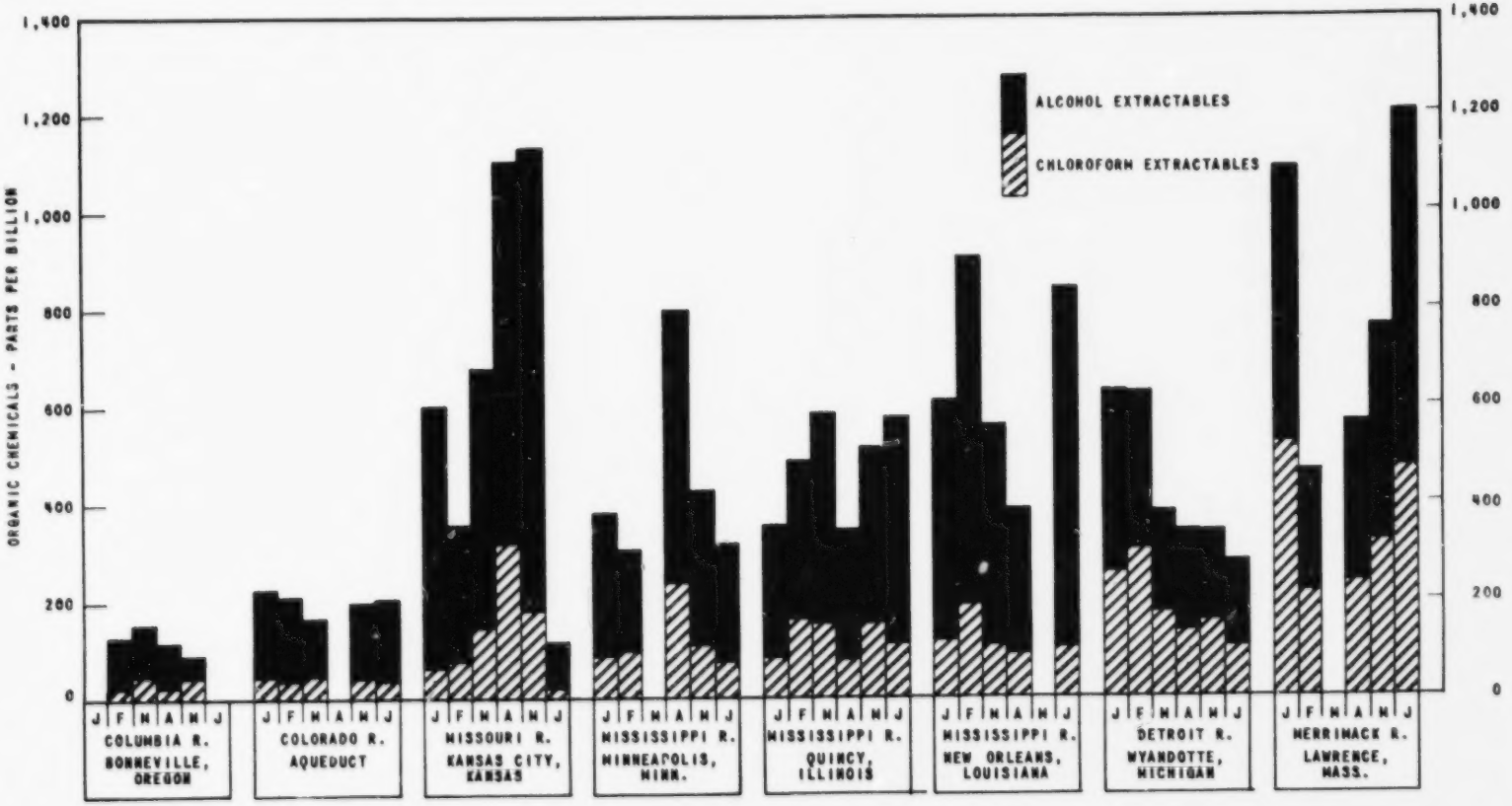
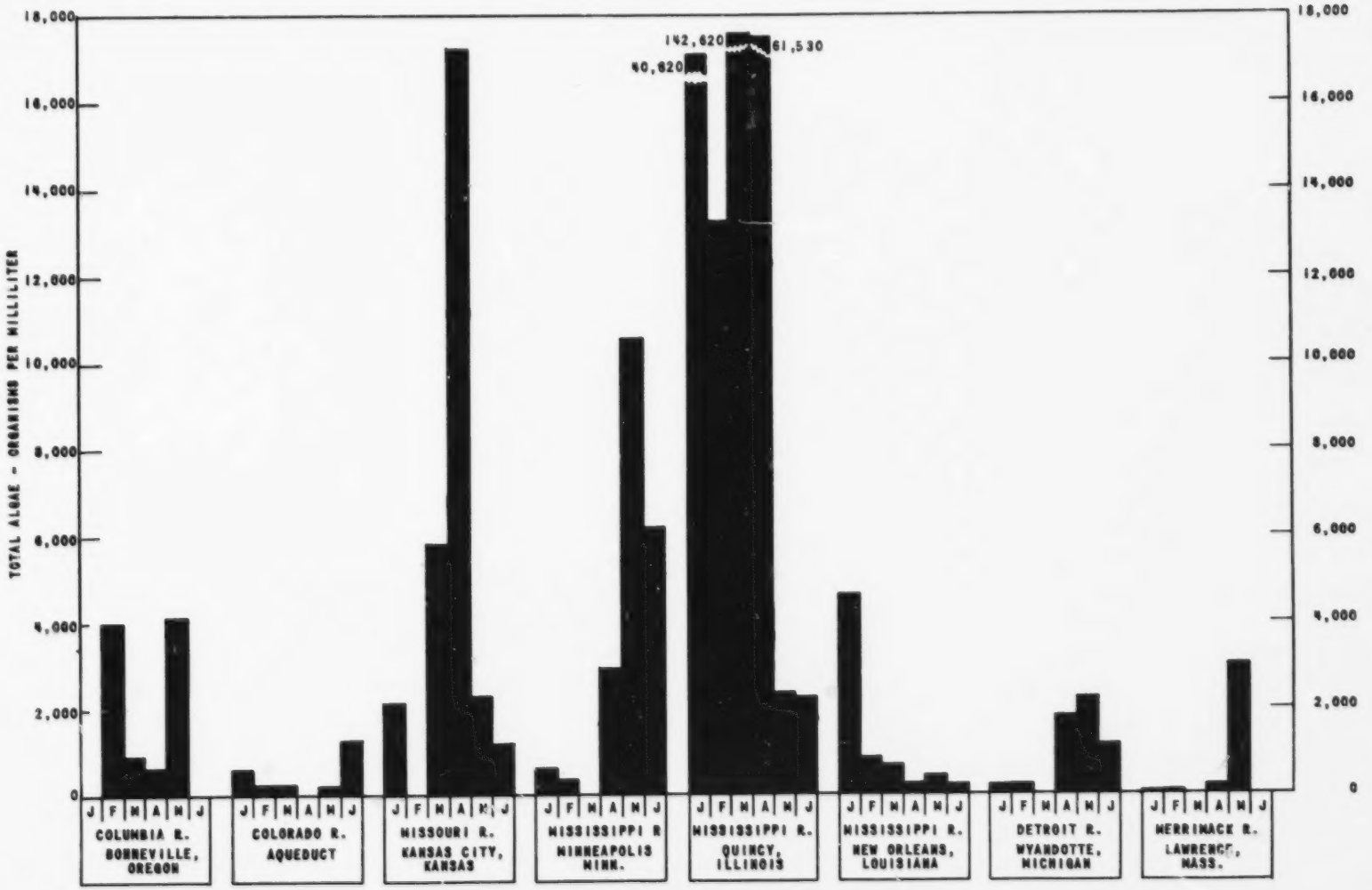


Figure 1
(ORGANIC CHEMICALS)



DATE OF SAMPLE - 1957

LOCATION OF SAMPLING STATION

Figure 2

(PLANKTON & ALGAE)

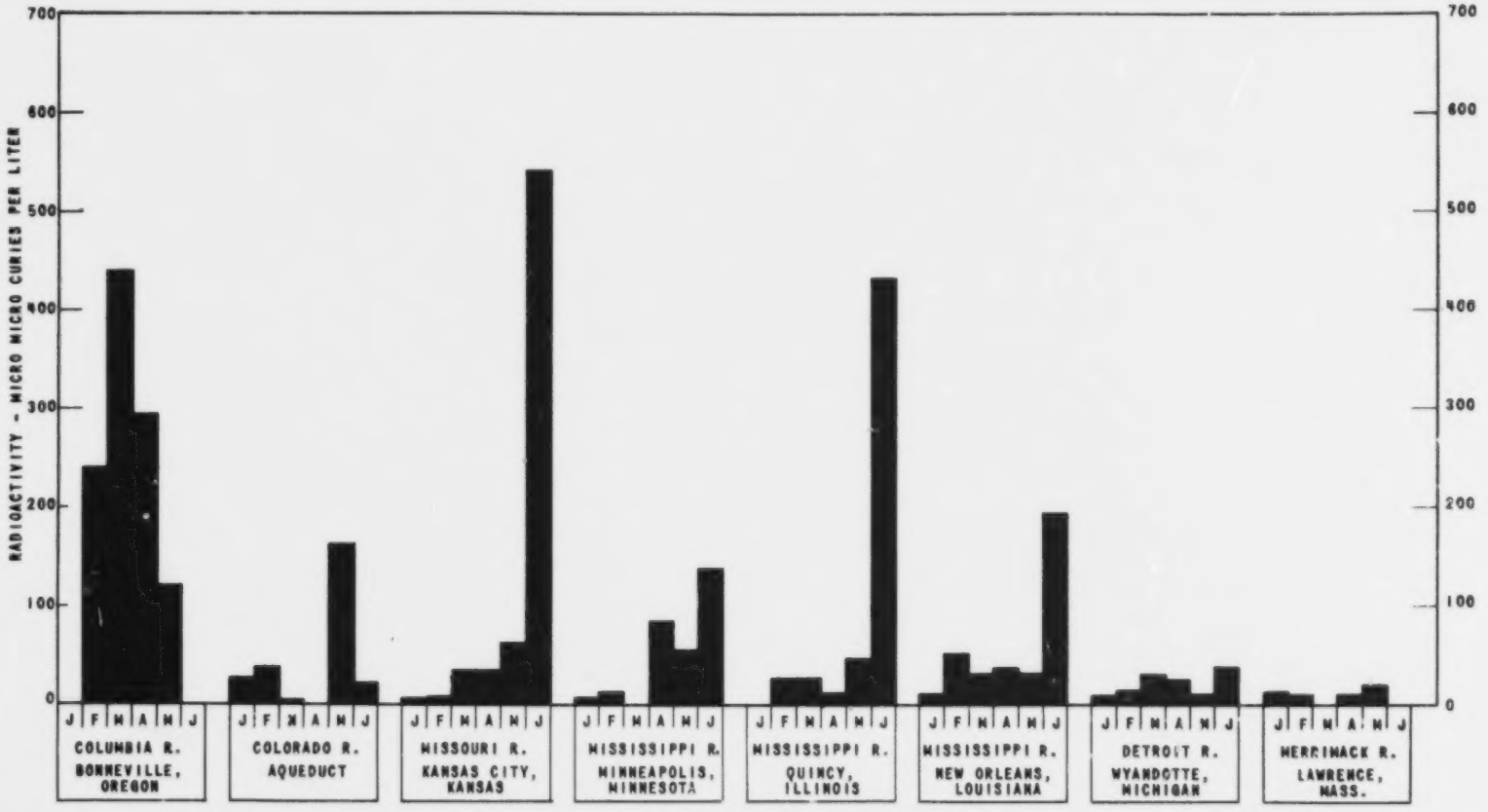


Figure 3
(RADIOACTIVITY)

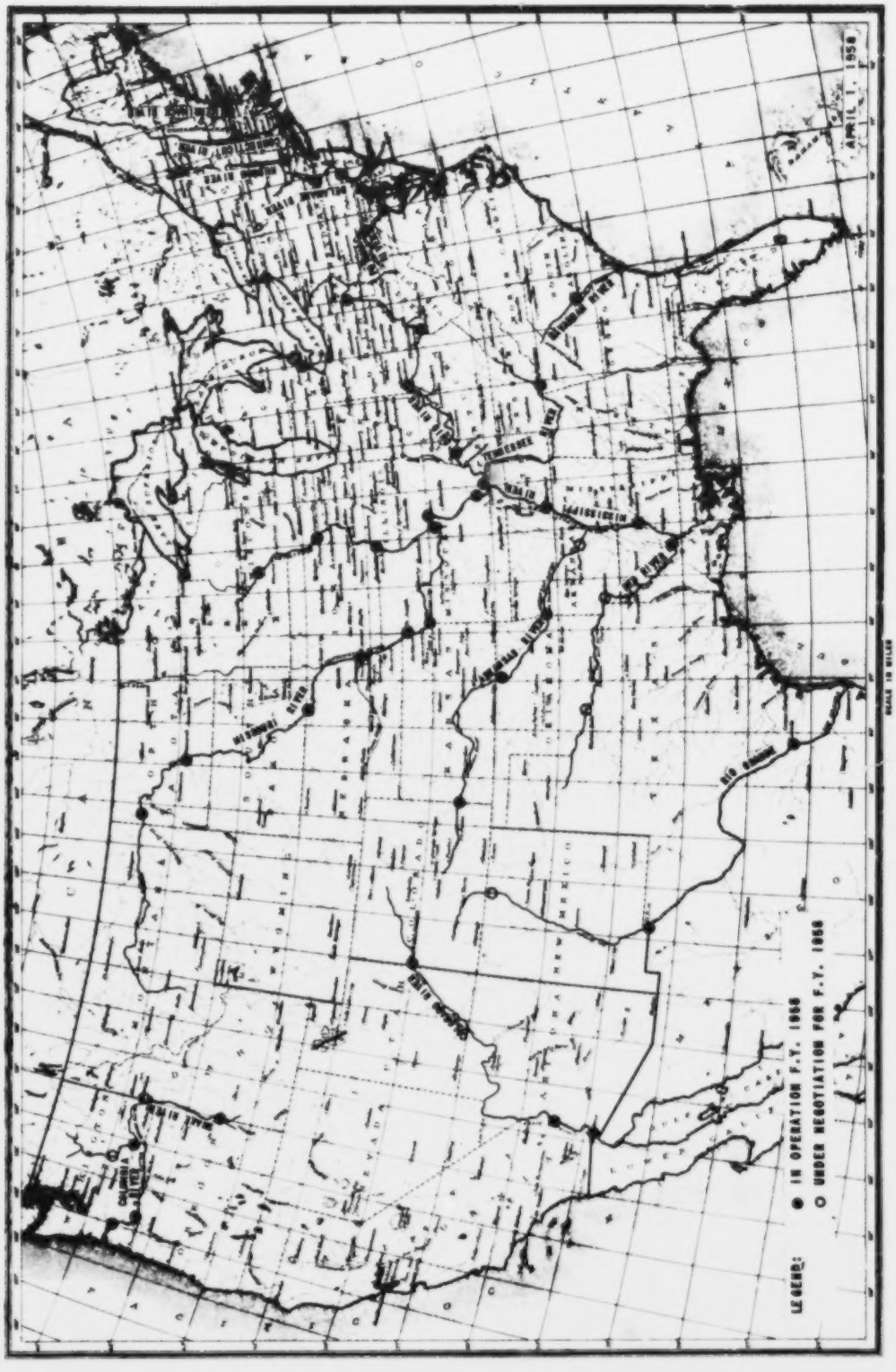

PHS WATER QUALITY BASIC DATA PROGRAM
NETWORK OF SAMPLING STATIONS
APRIL 1, 1958
LEGEND:
● IN OPERATION F.Y. 1958
○ UNDER NEGOTIATION FOR F.Y. 1958
COLUMBIA RIVER
SNAKE RIVER
CLEARWATER RIVER
YELLOWSTONE RIVER
MISSOURI RIVER
ARKANSAS RIVER
RED RIVER
RIO GRANDE

Figure 3